K-COTECH's Demands Forecasting and Inventory Management Plan*

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Ⅰ. Introduction

The term, demand forecasting, is estimating or predicting the future expected demand of products over time period (Bon and Leng, 2009). It has to consider the fluctuations in the market due to various factors. One of the main reasons why demand forecasting is important to firms is because it allows the firms to manage the inventory level (Hellen Oti, 2019). If the firm has full control of the inventory level perfectly, then the firm will naturally save money by many ways such as holding cost. Therefore, demand forecasting is considered one of the first steps to be done in supply management planning.

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However, demand forecasting is a very difficult task. It is very hard for people including experts to look into the future since dynamics of the market. It is why many products are to have short life cycles, mostly two years (Kurawarwala and Matsuo, 1996). Also, the characteristics of the products such as perishable inventory system (Nahmias, 2011) can make the demand forecasting more mysterious. Despite this difficulty, it is still essential for companies to spend their efforts to estimate demand in order to make better operation management plan.

In this article, a case study on demand forecasting and inventory management plan will be carried out in a specific firm, K-COTECH. The article will firstly, do a brief overview of K-COTECH. Then, secondly, current issues related to demand forecasting and inventory management will be reviewed. Thirdly, demand forecasting and improvement plans for inventory management on K-COTECH case will be explained. Finally, article will suggest the mid and long term operation improvement plan for the future.

Ⅱ. Overview of K-COTECH

2.1 K-COTECH

K-COTECH Co was established in Busan in 1988 and is a specialized company of Corrosion Prevention and Sealing which has been dedicated to corrosion prevention of various facilities for 32 years. To protect facilities from corrosive damage caused by seawater and chemical substances, such as nuclear power plants and thermal power plants, oil and gas works, as well as oil and chemical companies, steel companies, and ship facilities provide solutions that can be used permanently. Therefore, they contribute to the stable operation and cost reduction of each company. For the company business model, the company imports anti-corrosion products manufactured by Winn Coales Ltd. of 130 years of history through distribution rights in Korea and simultaneously sells and constructs products to domestic nuclear power plants, thermal power plants, and gas construction seawater facilities.

2.2 Key On-the-Job courses for K-COTECH's operation management

In order to protect the national facilities, such as nuclear power generation, metal, concrete structures, equipment facilities in all industries, including ships, shipyards, chemical plants, and oil refineries, K-COTECH first, imports raw materials based on special polymer ceramic materials(Named : ARCHCO) and second, applies detailed construction methods, such as Glass-lining or taping, are applied to various corrosion environments.

After promoting sales to potential customers, the Public Service Team is in charge of construction and the Quality Team is in charge of quality control at the same time, and the settlement will be completed by Finance Team at the final stage.

Ⅲ. Current issues related to demand forecasting and inventory management

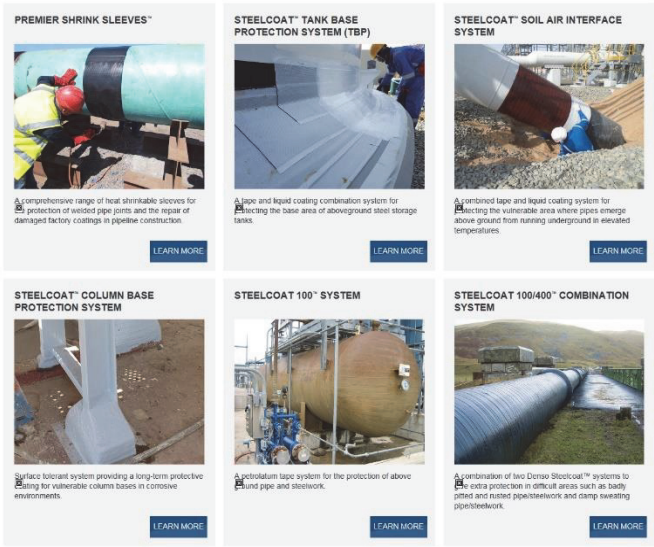
3.1 Characteristics of customers and products

For various power plant and oil refinery ships, they can predict demand in advance in the form of regular inspection and maintenance. However, there is also a demand for emergency construction due to corrosion and chemical problems, thus necessary to secure supply and adequate inventory. In this case however, maintaining proper stock is very difficult because it is not easy to stock all products with more than 100 detailed product lines for various corrosion environments, high temperature, and high-pressure chemical properties. Also, each product has a shelf-life and storage method varies, so the cost of transporting and stocking the product is very high; it is approximately 25% to 40% of the selling price.

3.2 Pain-point related to shelf-life

The average shelf-life of products is about 6 months. Within current supply chain, it takes about 4 months for products to arrive in Korea via sea transportation and to be stored in storage. Therefore the product should be used within 2 months of arrival in Korea. In case of a new project, it is possible to manage the inventory (ordering/

importing/managing) so that product supply is not disrupted through schedule management, but in case of emergency repair work, it is difficult to know when and what requests customers would make. Therefore there is always a difficulty in supply and demand. Also, there are problems with inventory shortage or overstocking for each item.



〈Figure 1〉 Products of K-COTECH

Long-term trust with existing customers is considered the most important business value in the market, which is composed of few consumers such as power plant, oil refiners and shipping companies. In order to fulfill customer satisfaction, sometimes products are imported by air cargo for emergency constructions, resulting in higher transportation costs than product service sales. To solve such problem, the company sought to establish a manufacturing facility for finished products in Korea by importing raw materials into bulk to produce products at the right time whenever necessary and increase shelf-life of products, but the preliminary feasibility review concluded that the cost for construction of finished production lines and storage facilities too high as well as maintenance costs. Also, transferring technology from the Headquarter is complicated therefore difficult to proceed.

Please be informed that the application areas (402B and HTL) for vessels are far more than expected.

Expected: 200㎡ / 20㎡ (402B / HTL)
Actual: 300㎡ / 150㎡ (402B/ HTL)

So, we are very short on stocks, especially HTL.
We can manage to use 402B since we also have air freight coming.
But for HTL, to do the job, we will need 1 ton of HTL by air freight as well.

Please let me know if you may confirm if having 1 ton of HTL by air freight will be okay (same 50:50 burden).

For final quotation, we are waiting on confirmation on cost for blasting and labor.
We should have these on Thursday morning.

Thank you.

Sincerely,
Jay

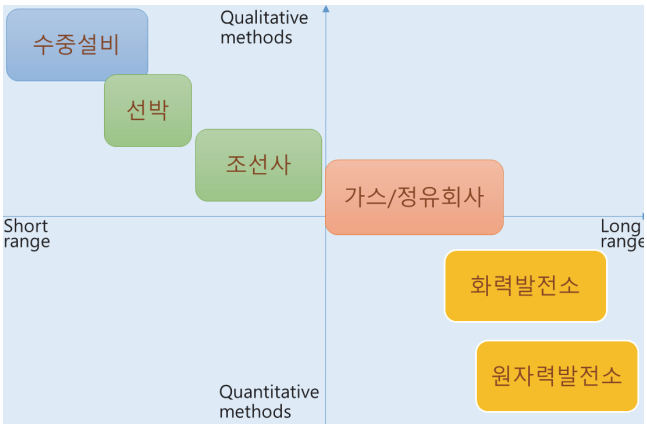
〈Figure 2〉 Relationship between consumers leads to high transportation cost

Ⅳ. Demand Forecasting and improvement plans for inventory Management

4.1 Methodology for Forecasting Demands

First, business sensitivity is considered on the characteristics of each consumer - types of forecasts by time horizon. Businesses have been responding to a few infrastructure demand groups such as nuclear and thermal power plants with a medium/long range forecast for more than a year. Also, they have been closely monitoring of change of national energy policies in recent years - De-nuclear of power plants, expansion of solar power/wind power generation (Chosun, n.d) - and mid/long-term impacts of global climate change and environmental regulations. Shipbuilding and ship maintenance-related demand groups are very sensitive to the global economy or trade activities, so that they can predict actual demand volatility as closely as possible. For close forecasts, Medium/Short-range forecast are generally applied.

Second, qualitative or quantitative methods in demand urgency exist. Quantitative methodologies are appropriate if demand can be predicted in advance in the form of regular inspection and repair work. Qualitative methodological are more practical for demand for emergency work that cannot be predicted due to corrosion and chemical causes.



〈Figure 3〉 Methods used by Business sensitivity and Demand urgency

4.2 Characteristics for Inventory Management cost and analysis methodology

Shelf-life and storage method vary for each product, therefore storage cost is high when stocking products. Detailed costs can be represented as following table:

Holding cost	Operating costs for inventory. Deterioration (degradation functionally deteriorating or causing problems) and warehousing costs are the biggest factor.
Ordering cost	External order cost for new inventory. In the case of marine transportation, the estimated quality for each product is ordered every month. Cost volatility is not high. Exceptional use for air transportation to respond to emergency situations
Setup cost	Costs for internal re-tuning and set up for increase of inventory. This cost is divided to working units and is cost for preventing contamination. This cost is of little importance.
Stock-out cost	Loss of revenue for lost demand. Possibility of losing business to competitors beyond customer dissatisfaction: penalty / Losing business. Respond by paying emergency expenses such as air transportation.

Stock out cost and deterioration cost are the two biggest considerations among the holding cost. Considering the short shelf-life of products, that must be used within two months of importation, and of big importance of maintaining quality and efficiency, since there is no secondary market through markdown. Therefore, low inventory strategy might be efficient. Although this report did not try because it was difficult to

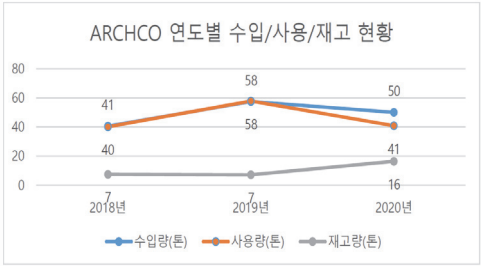
distinguish sales by item, it is believed that the proper inventory level management for each item through ABC Analysis will also be useful.

4.3 Current status of demand forecasting and inventory management of K-COTECH Co

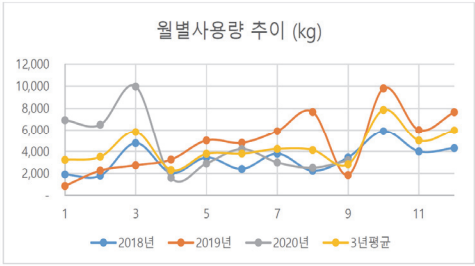
As presented earlier, due to a wide range of needs, product lines, and short shelf-life. Order minimum forecasted amount of products periodically every month; fixed amounts such as regular inspection of minimum estimated quantity per month and emergency maintenance work quantity based on past experience. Operating by maintaining the minimum amount of inventory according to the annual inventory plan and the minimum forecast for the type of emergency accidents that occur frequently.

〈Figure 4〉 K-COTECH Co. Flow chart

Accordingly, if the annual inventory (import/usage/stock) of ARCHCO is looked, the main material, annual imports and usage are almost the same. In 2020, the inventory has increased temporarily due to the delay of regular work scheduled for each demand due to the corona issue. The variability in monthly material usage, i.e. the seasonality, appears to be low.



〈Figure 5〉 ARCHCO years Import/Consume/Inventory chart



〈Figure 6〉 Monthly consumption chart

4.4 Problems and Improvement Measures

Major problems are potential opportunity costs for loss of sales opportunities due to minimum forecast orders and minimum inventory maintenance, and increased costs such as air transportation for emergency handling of excess orders. With these problems two questions can be considered; what are the constraints of predictable opportunities for potential sales? Do we need a methodological approach other than refinement of demand forecasting and inventory management?

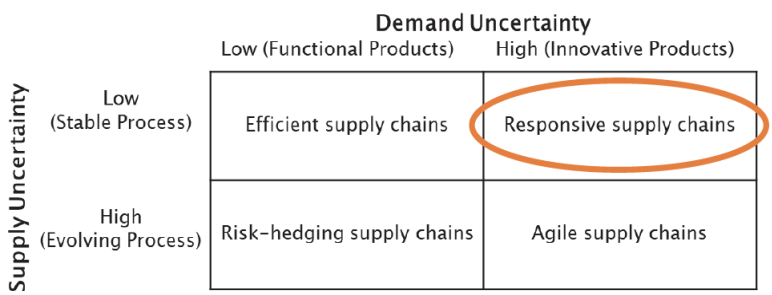
(1) Application of methodologies for demand forecasting and inventory management

One of the methodologies is The Newsvendor Model. The current order quantity is determined to meet future demands. When, there is excessive inventory due to large orders, then excess of inventory. Whereas if there are fewer orders, then loss of sales opportunities due to lack of inventory. The short Shelf-life has similarity to perishable goods, such as newspapers. Although similarities can be found in the above aspects, Newsvendor assumes that due to the nature of the newspaper. There is only one production or purchase opportunity every day, and that the cost per copy and the cost for returning are regarded as the fixed cost However, in the case of K-Cotech, the size of difficulty, construction period, the type and capacity of items, and construction unit price varies and there are characteristics that cannot be returned. Therefore, maximizing corporate profits by using Newsvendor model is difficult to meet the theoretical premise to actually apply orders therefore ineffective.

Another methodology is the Economic order quantity (EOQ) Model. To apply EOQ model, the demand and lead time should be predictable in advance and contant. Also it is difficult to conceptually reflect Stock-out cost therefore use of analysis methodology seems quite limited.

(2) Improvement measures from the supply chain management perspective

Supply Chain Management (SCM) Strategy looks for appropriate Supply Chain strategy that reflects the uncertainty of supply and demand as well as whether the products are functional or innovative. Functional products are products with low diversity and easy for demand forecasting due to long product life cycles, with lower margin of loss of obsolescence compared to innovative products, while innovative products have the opposite characteristics. This issue can be classified as an innovative product due to its high variety of products and high cost of deterioration due to difficulty of long-term storage. Also, since uncertainty in demand is bigger than uncertainty in supply, the Responsive Supply Chain strategy is decided to be valid in accordance to the classification table below.



〈Figure 7〉 Uncertainty Framework

To increase the accuracy and response of demand forecasting, usage of IT technology such as big data, Internet of Things using sensing technology introduced throughout the industry. Detecting abnormalities such as flow rate, temperature, and vibration in advance and take necessary preventive measures is needed. Real-time monitoring for more accurate prediction of demand volatility based on recovery plan and establishes

an early warning system can be a solution. This will reduce the proportion of emergency maintenance work and increase the proportion of fixed services so that orders and inventories can be as close to actual demand as possible. Product data management, early design collaboration, and supplier hub strategies can be considered as strategies to reduce supply uncertainty (Hub strategies are described for location strategy perspective).

(3) Improvement measures from the perspective of location strategy/ process strategy

Hub and Spoke Strategy suggests the current business operation method of importing directly from the UK headquarters changed into the Asian Hub, which encompasses Korea, China, Hong Kong and Singapore. Compared to connecting different locations from headquarters, connection routes through the hub can be shorter, improve order lead times, and reduce storage costs through economies of scale. In terms of demand forecasting, the problematic issue of diversity and volatility of imported products for each country can be alleviated through the Effects of Statistical Distribution; both product family and aggregated product forecasts are more accurate than individual product forecasts.

〈Figure 8〉 Route comparing before and after hub and spoke strategy

However, the difference in the composition of imported items and the cost-sharing , operation management between importers of different countries with different ownership entities requires coordination of opinions on matters, and takes a lot of time to make decisions. These are the operational inefficiencies of Decentralized Supply Chain. In order to operate objectively and efficiently, it is necessary to build a management operator and hub storage facility through joint investment, but considering the size of sales and approval issues related to each country, it will be difficult to become a realistic alternative in the near future.

Ⅴ. Conclusion: Mid- to Long-term operation improvement plans

5.1 Demand forecasting and inventory management sectors

In order to improve prediction accuracy, companies must track error of predictions and reality over a long period of time and use statistical models to refine these. Also companies should keep an eye on changes such as macro-environment, major policies, and new technologies that affect market demand and supply. Industrial infrastructure and petrochemical industrial complexes such as thermal power and nuclear power generation in Korea have been built intensively since the 1960s and 1970s, and most facilities are aging. This year alone, a large explosion occurred at Lotte Chemical's Daesan plant in Chungnam Province in March. In case of LG Chem, fire and explosion occurred at Daesan Plant in May, and toxic gas leakage occurred at Ulsan Plant in August.

Also, since the first commercial operation of the Gori Nuclear Power Plant in 1978, a total of 21 nuclear power plants are currently in operation, and Wolseong Nuclear Power Plant 1 has entered a phase of aging to become a political and social issue. These environmental changes are expected to increase the volatility of future demand, or the scale and urgency of accidents, and it is necessary to take a systematic approach that incorporates IT cutting-edge technology based on internal data related to construction and performance over the past 30 years. Using the Internet of Things and sensing technology, the company fosters pre-incident services which is the proactive

service detecting abnormalities such as flow rate/flow temperature vibration, and implements necessary preventive measures, and implements core technologies by acquiring related new technology startups.

Currently, 'Unstructured Pipe Damage Assessment Technology' has been developed to the level of practicality (Kim, 2019), and it is suggested to foster it as a future growth engine for K-Cotech as a technology that can measure the extent of damage and aging of pipes installed in oil refiners and nuclear power plants.

5.2 Coordinating the Supply Chain through Contracts

In order to maximize the total profit of the supply chain, the company will push for a mid- to long-term contract change with both the supplier (UK headquarter) and the buyer (K-Cotech Co., Ltd.) to increase the profit at the same time. Local buyers take all the risk of costs occur due to inventory shortage or overstock in the current supply structure. Supplier will only need to meet Buyer's orders. Purchasers will order less than the order quantity that maximizes the total profit of orders in the supply chain. To solve this problem, it is suggested to share risks using a new form of contract. First, it is Buy-back contract; calculation of deduction from next purchase amount, not actual return of items. Second, revenue or profit sharing contract; buyer will no longer maintain a minimum inventory strategy, but will maximize revenue and Supplier will share such performance in services other than product sales while maintaining adequate spare inventory to enhance service response and customer satisfaction. Third, through negotiations with Asian material warehouses and logistics hub; K-Cotech Co., Ltd. will lead the construction of Asia Hub near Busan Port in Korea through negotiations with the headquarters to operate the Asian logistics center. In the Asian region, freight rates are relatively low for transportation from Europe, so a rapid order-delivery leads time system is established using air cargo (Redesign of Network). Afterwards, the company will build a differentiated SCM with multi-functioning warehouse that can create added value such as simple mixing and manufacturing in the local warehouse.

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